Listing of Claims

This Listing of Claims will replace all prior versions, and listings, of claims in the application.

Claims 1-20 (Cancelled)

21. (Currently Amended) A method of managing a cluster of networked resources and resource groups using rule-based constraints in a scalable clustering environment, the method comprising the steps of:

building a globally optimal cluster configuration of said ~~cluster of~~ networked resources in accordance with said rule-based constraints and a current state of said resources, including identifying for ~~wherein~~ each of the resources and resource groups ~~has~~ an availability and quality of service, which ~~and the availabilities and quality of services of the resources~~ are determined by dependencies among the resources and resource groups, resource equivalency, user preferences, constraints on the resources, ~~events,~~ and network policies[[,]];

bringing said cluster of networked resources on-line in a systematic manner, given the current state ~~states~~ of each of the ~~said~~ resources and resource groups, and their ~~said~~ dependencies, user preferences, constraints on the resources, ~~events,~~ and network policies,

with said cluster of networked resources on-line, determining dynamic dependencies of and configuration information about said cluster of networked resources, ~~including determining said dependencies and configuration information~~ (i) statically at said step of building and said

step of bringing said cluster of networked services ~~cluster initialization and~~online and (ii) dynamically during cluster operation in accordance with said rule-based constraints,

supporting startup, operation and shutdown of said cluster of networked resources according to current policies, and system events, and said rule-based constraints;

separating said dependencies among resources and resource groups, user preferences, constraints among the resources, system events, and current policies into (i) a first, static rules based group and (ii) a second, dynamically changing events based group, wherein said first group captures the static resources ~~and the occasionally changing resources~~, including, for each resource~~service~~, a ~~the~~type and quality of the supporting resources ~~services~~needed to enable said each resource~~service~~, wherein said step of separating is implemented according to said rule-based constraints; and

combining said first and second groups in a systematic manner only when needed to build the said globally optimal cluster configuration, ~~whereby by separating the dynamic dependencies, preferences, constraints, events and policies from other dependencies, preferences, constraints, events and policies, and then combining said first and second groups in a systematic manner~~ and only when needed during operation to modify and realign the current state of said cluster to said globally optimal cluster configuration, or an alternative globally optimal in view of said current policies, said system events and said rule-based constraints, ~~a desired level of automation is achieved in the coordination and mapping of resources and services~~.

22. (Currently Amended) A method according to Claim 21, wherein said step of combining further comprising~~the further steps of~~:

continuously monitoring ~~system~~ _cluster-wide_ events and comparing the current cluster

state with ~~a~~ _the globally optimal cluster configuration_~~desired-state~~, and _upon detecting_ ~~whenever~~

~~there is~~ a discrepancy between said current _cluster_ state and _said globally optimal_ ~~desired~~ _cluster_

configuration~~states~~, realigning _said_ ~~the~~ cluster _of networked_ resources, including ~~the step of~~

issuing commands to the _networked resources comprising the current_ cluster _state_ ~~resources~~ to

bring about the realigning;

providing a group of cluster ~~services~~_resources_, including:

i)   a persistent cluster registry to store and retrieve the configuration of the cluster _of_

the networked resources,

ii)   topology ~~services~~_resources_ for detecting node and communication adapter failures

within said cluster of networked resources,

iii)   messaging for selected communications between a central resource and all other

resources _comprising the cluster of networked resources_, and

iv)   a group ~~services~~_resources_ facility for electing one of the resources as the central

resource at cluster initialization, and _upon determining that_ ~~whenever~~ an existing

central resource is unable to provide the ~~services~~_resources_ thereof,

delivering _notification of system_ events to a coordinator _to process_ ~~, said coordinator~~

~~combining~~ said _system_ events _in accordance_ with said _rule-based constraints_ ~~rules and objectives~~

to arrive at a response to said _system_ events;

translating the response into commands to the resources _that realign_ ~~, each of the~~

~~commands containing all~~ the _availability, quality of service and related dependencies to execute_

said commands ~~state needed for execution of the command~~ by a _resource_ manager _associated_

with each of said ~~of one of the~~ resources, including <u>issuance of</u> ~~the step of issuing~~ the commands in a partial order <u>sequence where necessary, in view of</u> ~~given by~~ said <u>each resource's</u> dependencies; and

not sending out a <u>"next"</u> ~~new~~ command until the central resource detects a positive outcome of the <u>current command or</u> commands that the execution of said <u>next</u> ~~new~~ command depends on.

23.   (Currently Amended) A method according to Claim 22, wherein:

said coordinator<u>, by said rule-based constraints,</u> ensures that<u> the current cluster state is realigned with said globally optimal cluster configuration, or an alternative globally optimal cluster configuration</u> ~~globally optimal solutions get deployed in the cluster~~ in response to <u>system</u> events in <u>said</u> ~~the~~ cluster<u>, wherein</u> ~~; and~~

all events and command feedback <u>from said cluster in response to a current or next command is</u> ~~are~~ directed to said coordinator.

24.   (Currently Amended) A method according to Claim 21, <u>further</u> comprising ~~the further steps of~~:

providing an optimizer module for computing <u>said</u> ~~a~~ globally optimal <u>cluster configuration, or an alternative globally optimal cluster configuration</u> ~~solution~~ based on said <u>rule-based</u> constraints and <u>to realign the</u> ~~to~~ current state of <u>said</u> ~~the~~ cluster<u> when needed in response to system events</u>;

using the optimizer module for realigning the current configuration state in accordance with said rule-based constraints ~~recomputing the globally optimal solution~~ whenever an objective value calculated in view of the current configuration state ~~of a deployed solution~~ is below a certain value calculated for the globally optimal cluster configuration~~as compared to a proposed solution~~, including ~~the step of~~ feeding back to the optimizer module an artificially generated event that forces the optimizer to realign the current network configuration to a cluster configuration approaching or equivalent to said global optimal cluster configuration and said alternative global cluster configuration~~recompute the global solution~~;

providing the optimizer module with a snapshot of a ~~the~~ current state of the cluster of networked resources;

wherein the ~~step of using the~~ optimizer, ~~for recomputing the globally optimal solution includes the step of said optimizer,~~ given said snapshot, calculates and proposes ~~proposing~~ an approximately globally optimal cluster configuration that takes into account said current state of the cluster and long-term objectives defined for the cluster in accordance with said rule-based constraints.

25. (Currently Amended) A system for managing a cluster of networked resources and resource groups using rule-based constraints in a scalable clustering environment, comprising apparatus for:

building a globally optimal cluster configuration of the networked ~~said cluster of~~ resources, in accordance with said rule-based constraints and a current state of said resources and including

identifying wherein each of the resources with has an availability and quality of service, which and the availabilities and quality of services of the resources are determined by dependencies among the resources and resource groups, resource equivalency, user preferences, constraints on the resources, events, and network policies,

bringing said cluster of networked resources on-line in a systematic manner, given a current state states of each of the said resources and resource groups, and said dependencies, user preferences, constraints on the resources , events, and policies, in accordance with said rule-based constraints,

with said cluster of networked resources on-line, determining dynamic dependencies of configuration information about said cluster of networked resources, including determining said dependencies and configuration information (i) statically at said step of building and said step of bringing said cluster of networked resources online initialization and (ii) dynamically during cluster operation,

supporting a startup, operation and shutdown of said cluster of networked resources according to current policies, and system events, in accordance with said rule-based constraints,

separating the said dependencies among resources, resource groups, user preferences, constraints among the resources, system events, equivalencies among said resources and said resource groups and current policies into (i) a first, static rules based group and (ii) a second, dynamically changing events based group and (ii) a second, dynamically changing events based group, wherein said first group captures the static resources and the occasionally changing resources, including, for each resource and resource groupservice, the type and quality of the

supporting resources, resource groups and their equivalencies services needed to enable said each resource and resource groupsservice, and

combining said first, static and second, dynamically changing events based groups in a systematic manner only when needed to build the said globally optimal cluster configuration at startup, and only when needed during operation to modify and realign the current state of said cluster to said globally optimal cluster configuration in view of said current policies, said system events, said equivalencies and said rule-based constraints, whereby by separating the dynamic dependencies, preferences, constraints, events and policies from other dependencies, preferences, constraints, events and policies, and then combining said first and second groups in a systematic manner only when needed, a desired level of automation is achieved in the coordination and mapping of resources and services.

26. (Currently Amended) A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps of managing a cluster of networked resources, including resource groups, using rule-based constraints in a scalable clustering environment, said method steps comprising:

building a globally optimal cluster configuration of said cluster of networked resources, in accordance with said rule-based constraints and a current state of said resources, including identifying wherein each of the resources with has an availability and quality of service, which and the availabilities and quality of services of the resources are determined by dependencies among the resources and resource groups, resource equivalency, user preferences, constraints on the resources, events, and network policies,

bringing said cluster of networked resources on-line in a systematic manner, given a current state ~~states~~ of each of the ~~said~~ resources and resource groups, and said dependencies, user preferences, constraints on the resources~~, events~~, and network policies,

with said cluster of networked resources on-line, determining dynamic dependencies of configuration information about said cluster of networked resources and resource groups~~, including determining said dependencies and configuration information~~ (i) statically at said step of bringing said cluster of networked resources on-line ~~initialization~~ and (ii) dynamically during cluster operation, in accordance with said rule-based constraints,

supporting startup, operation and shutdown of said cluster of networked resources according to current policies, and system events, and said rule-based constraints,

separating said dependencies among resources and resource groups, user preferences, constraints among the resources, system events, equivalencies and current policies into (i) a first, static rules based group and (ii) a second, dynamically changing events based group, wherein said first group captures the static resources ~~and the occasionally changing resources~~, including, for each resource and resource groups ~~service~~, the type and quality of the supporting resources, and equivalencies of said resources and said resource groups ~~services~~ needed to enable said each resource, and said resource groups ~~service~~, and

combining said first and second groups only when needed to build the said globally optimal cluster configuration, ~~whereby by separating the dynamic dependencies, preferences, constraints, events and policies from other dependencies, preferences, constraints, events and policies, and then combining said first and second groups in a systematic manner~~ and only when needed during operation to modify and realign the current state of said cluster to said globally

optimal cluster configuration in view of said current policies, said system events, said equivalencies and said rules-based constraints, to achieve a desired level of automation ~~is achieved~~ in the coordination and mapping of networked resources ~~and services~~.

27.   (Currently Amended) A method according to Claim 24, wherein:

the providing step includes ~~the step of~~ providing a preprocessor module and a postprocessor module;

wherein the preprocessor module includes a preprocessor entry queue, the optimizer module includes an optimizer input queue, and the postprocessor module includes a postprocessor input queue;

creating a preprocessor task to implement a decision to reallocate ~~do~~ a resource or a resource group, wherein said preprocessor task ~~reallocation results in the creation of a preprocessor task that~~ is provided to ~~deposited in~~ the entry queue of the preprocessor module; and

wherein said preprocessor task is an object having an entry method that, when invoked, results in the preprocessor task being executed, and execution of the preprocessor task results in either a postprocessor task being provided ~~deposited~~ in the postprocessor input queue, an optimizer task being provided ~~deposited~~ in the optimizer input queue, or both;

scheduling the postprocessor task ~~is scheduled~~ by an invocation of the entry method associated with the postprocessor task;

scheduling the optimizer task ~~is scheduled~~ by an invocation of the entry method associated with the optimizer task; and

executing execution of the optimizer task results in a postprocessor task provided being deposited in the postprocessor input queue.

28. (New) A system for managing a dynamic scalable cluster of heterogeneous networked resources, and networked resource groups, by arranging the resources and resource groups in an optimal cluster configuration for servicing dynamic scalable resource needs of a network of computer systems in accordance with a set of rule-based constraints, wherein each said resource and resource groups includes a resource manager and a set of attributes, and is allocated and reallocated by the system in view of its dependencies to other resources, equivalencies to other resources and a specified load-based policy for responding to event-driven changes in resource needs, and/or changes in said attributes defining each of said heterogeneous resources, the system comprising:

a cluster registry to store and recall attributes and resource manager data that define each said heterogeneous resource and resource group;

a mechanism for detecting differences between current resource attributes defining each of said heterogeneous resources and resource groups, and stored attributes associated with said globally optimal cluster configuration;

an optimization problem solver that responds to differences between detected current resource attributes and attributes associated with said optimal cluster constraint-based configuration by generating a set of instructions for controlling and realigning said current, detected resource attributes; and

a coordinator for implementing said set of instructions to control said detected current, resource attributes to operate said cluster according to said optimized cluster constraint-based configuration.

29. (New) The system as set forth in claim 28, wherein said attributes include name, type, capacity, priority and state, and wherein said state indicates readiness of each said resources' availability as one of offline, online and failed.

30. (New) The system as set forth in claim 28, wherein said attributes include resource availability, equivalencies and quality of service.

31. (New) The system as set forth in claim 28, wherein said optimization problem solver operates locally when operating upon a proper subset of resources, and operates globally when operating upon said cluster.

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